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(19)

(54) PLANT GROWTH MEDIUM

(71) We, FISONS LIMITED, a British Company, of Fison House, 9, Grosvenor Street, London, W.1., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a composition, notably one for use as a plant growth medium.

The invention provides a plant growth medium comprising a laminated structure having a layer of foamed plant physiologically acceptable synthetic resin incorporating therein a plant nutrient and/or a material which can be penetrated by plant roots and a layer of plant seeds; and a coating whereby the laminate structure is held together.

The invention is of especial use in providing plates of resin coated with grass seed for use in growing turf. For convenience the invention will be described with reference to this preferred use. Where other types of plant are to be grown, the invention is carried out essentially as described below with such minor alterations, e.g. different spacing of the seeds on the surface of the foamed resin as may be appropriate to the particular plant to be grown.

For simplicity the invention will first be described with respect to a particularly preferred embodiment thereof which is shown in diagrammatic section in the accompanying drawing.

The foamed layer 1 consists of an open pored polyurethane foam having imbedded therein particles 2 of peat, slow release fertilizer (e.g. urea/aldehyde condensates, such as isobutylenediurea or glycoluril) and other fertilizer or agricultural ingredients such as phosphate fertilizers, fungicides, pesticides and growth regulants. In order to aid germination of the seeds and initial plant growth, it is preferred to provide a layer 3 of peat and/or short term fertilizers, such as mono-ammonium phosphates on top of layer 1. On top of layer 3 is a layer 4 of seeds. The top surface of the resulting laminate is provided with a coating 5 which holds the laminate together. All the components of the laminate are dry in order to inhibit premature germination of the seed.

The laminated structure may be formed either as a long strip to be rolled up or as a series of short pads, say 1 metre by ¼ metre. Where short pads are formed, it may be desired to form these as self supporting rigid or semi-rigid trays.

The strips or pads represent a plant growth medium ready sown with seeds which may be sold as such, e.g. as repair pads for making good existing lawns, or as pads which may be used to lay a new lawn on levelled and prepared soil. Alternatively, the pads may be passed to a growing environment, e.g. a greenhouse or plastic tunnel house, where the seeds are germinated and initial growth is carried out under closely controlled conditions to produce a high quality turf which is then sold or used as a growing plant.

The above simple form of pad or strip may be modified in a number of ways. Thus, different forms of foamed resin material may be used. The foamed resin for present use is preferably either biodegradable or incorporates an additive which renders it biodegradable in a reasonable period, e.g. 6 to 12 months. However, it is preferred that the resin should not be degraded over a period of 4 to 8 weeks to such an extent that it can no longer be handled. Furthermore, the resin should be plant physiologically acceptable, that is it should not be phytotoxic to any appreciable extent. Suitable types of resin for present use thus include urea/aldehyde condensation products, notably those derived from longer chain aldehydes, such as C_4 to C_8 aldehydes e.g. isobutyraldehyde or crotonaldehyde; polyurethanes derived from polyols or polyethers, notably from block copolymers of ethylene of propylene oxides or from triols of the formula

$$HOX—CH_2—CHOH—CH_2XOH$$

where X is a poly-alkylene polyether, e.g. of formula

$$—(C_3H_6O)_n.$$

The isocyanate reactant used in preparing the polyurethane is typically a toluene di-isocyanate, e.g. 2,4 or 2,6 toluene di-isocyanate or mixtures thereof; although other di- or poly-isocyanate reactants may be used, e.g. diphenylmethane di-isocyanate, naphthylene di-isocyanate, hexamethylene di-isocyanate or triphenylenethane —pp'p triyl tri-isocyanate. It is preferred to use a predominantly open pored foamed resin. The pore type and structure are affected, *inter alia*, by the nature of the reactants which are used to prepare the resin, the viscosity of the resin mix before and during foaming, the nature of the foaming agent and the nature and amount of any wetting agents which may be present. These factors may be balanced, as is known, in a number of ways to produce an optimum foam. Thus, in a polyurethane foam, open pore structure can be achieved by omitting the wetting agent which is normally used to control cell structure during foaming. If the foam is open pored, it will usually absorb water. However, if this is not the case, it may be necessary to modify the foam, e.g. by treatment with an aqueous wash of acid or alkali or a solvent wash, to render it water wettable.

The foam serves as the root growth medium for the seeds planted thereon. It is preferred that the foam be sufficiently rigid to act as a self-supporting carrier for the germinated seed/root bed. This may be achieved by alteration of the pore size and structure, commensurate with the requirement of ease of root penetration. Alternatively, stiffening means such as rods or fibres may be introduced into the resin during foaming. The stiffening means need not be integral with the foam and could take the form of a rigid base plate upon which the foam is laid for germination of the seeds. The manner in which the foam is formed may also effect the rigidity thereof. Thus, polyol based polyurethanes form a surface skin during foaming and this skin may impart sufficient rigidity to the foam.

The resin mixes for present use may contain such other ingredients as are normally used in the production of foamed resins, e.g. blowing agents, curing agents and wetting agents to control pore formation, as well as other ingredients useful in the propagation and cultivation of plants, e.g. fungicides, pesticides, growth regulants and pigments.

The foamed resins may be formed into pads or sheets of the desired shape and size by any suitable method. Thus, the resin may be cast or moulded into trays or pads; or may be sprayed on to a moving belt to form a continuous strip of foaming resin. For convenience, the foam forming stage will be described by way of illustration with respect to a polyurethane foam. Where other resins are used it will be appreciated that modifications of the process described may be necessary.

The resin mixture is conveniently formed from a feed of the water foaming agent and the polyol and/or polyether reactant and a separate feed of the isocyanate reactant which are fed to a mixer nozzle. This nozzle may feed an injection mould or casting or may feed material on to a moving belt. If desired, as indicated later, the solids for incorporation into the foam layer 1 may also be fed to this mixer nozzle. The mould or casting may be such as to form a single pad or tray of foam directly or may produce a block of foam which is then sliced to give separate pads or trays of the desired thickness. Where a polyol based resin is applied to a moving band, a continuous strip of foam having a solid skin will be formed. This is then split horizontally to form two strips each having an open pored face. These strips are self-supporting to an extent due to the skin around the edges and one major face. The strips may then be cut into pads of the desired shape or wound on to a reel.

As indicated above, the foamed pad or strip also incorporates fertilizer and/or root penetrable particles. Whilst the fertilizer ingredients may be any of these normally used in the cultivation of plants, e.g. urea, potassium or ammonium salts such as the chlorides, nitrates, phosphates or sulphates and superphosphates, it is preferred to use slow release sources of plant nutrients such as urea/aldehyde condensation products (e.g. isobutylendiurea), glycoluril or phosphate rock. It will be appreciated that in some cases certain fertilizer ingredients could interfere with the foaming and/or curing of the resin and that some simple trial and error test may be required to establish whether a given resin/fertilizer combination is compatible or not. Furthermore, it will be appreciated that some resins are thermselves sources of plant nutrient, in which case it may not be necessary to incorporate separate plant nutrients into the foamed resin.

In addition to the plant nutrient in the foamed resin, it will usually be desired to incorporate particles of a material which can be penetrated by plant roots during growth of plants, such as peat, in order to

aid close contact between the plant roots and the nutrient solution which will be held in the pores of the foamed material during growth of the plant.

The particles of fertilizer or root penetrable material may be incorporated into the foam in a number of ways. As indicated above, the particles may be mixed with one of the components of the resin before foaming. Where uneven distribution of the particles through the foam, e.g. a concentration of particles at or near one face of the foam, can be accepted, it may be sufficient to coat the surface, e.g. the moving band, on which the resin is allowed to foam with the particles. These are then picked up by the resin and incorporated into the foam during dispensing of the resin on to the surface. Alternatively, the particles may be scattered on to the foaming mixture.

As indicated above, it may be desired to have a layer 3 of short term fertilizers. This may contain any suitable fertilizer and may in fact be provided by the surface concentration of fertilizer formed during the foaming of the resin as just described above. Where a separate layer of fertilizer is applied after foaming, this is applied to an open pored surface of the pad or sheet of resin. Thus, where a root impenetrable skin is formed on the resin during foaming, this skin is removed from the surface to which the fertilizer is to be applied. This can be done, for example, by cutting the pad or sheet of foamed resin in half horizontally to halve the thickness of the pad or sheet and then inverting the top half to expose the cut faces. The fertilizer layer may be applied by any suitable method, such as a roller dribbler, and may incorporate a binder or adhesive to retain it in position on the foamed resin.

The seeds of the plant which it is desired to grow are then applied to the foamed resin/fertilizer laminate. The rate of application and spacing of the seeds will vary from plant to plant as is known and any suitable application method may be used.

Finally the foamed resin/fertilizer/seed laminate structure is given a coating whereby the seeds are held in place. It is preferred to spray a liquid binder/coating on to the seed layer which impregnates the top layers of the laminate structure. Suitable coating sprays for present use include aqueous solutions or emulsions of soil stabilisers, e.g. those sold under the Registered Trade Marks of Arrasol or Unisol, and solutions or emulsions of urea/aldehyde condensates or precursors thereof which polymerise *in situ*. If desired, this coating may also be sprayed on to the other surfaces of the laminate structure and it may be necessary to treat the plant growth medium further, e.g. by heating, in order to ensure drying and/or curing of the coating.

The seeds on the pads or sheets of the invention may be germinated and grown using normal propagating techniques. Where the seed is grass, and it is desired to lay a lawn directly, the pads or sheets are laid directly on flattened and prepared soil as if they were conventional turves. If need be, the pads or sheets can be pinned in position, e.g. on slopes or banks. However, where it is intended to germinate the seeds and sell the pads or sheets as growing turves, it is preferred to place the pads or sheets on a plant root impervious surface to minimise rooting of the grass or plants in the substrate. This may be achieved by propagating the plants on a concrete substrate. Alternatively, the same effect can be achieved by providing the base of the foamed resin with a plant root impervious layer. This layer may be integral with the foamed resin, as is the case where a skin has been formed during foaming of the resin; or may be attached thereto during production of the pad or sheet. Thus, an adhesive can be applied to the base of the pad or sheet and a film of, for example, polyethylene stuck to the pad or sheet. The impervious layer prevents roots penetrating the substrate on which the pad or sheet is propagated. When the pad or sheet is laid in its final growing site, e.g. is laid as a turf in a lawn, the impervious backing is pulled off to permit the roots to penetrate into the soil and thus knit the turf into the lawn.

WHAT WE CLAIM IS:—

1. A plant growth medium comprising a laminated structure having a layer of foamed plant physiologically acceptable synthetic resin incorporating therein a plant nutrient and/or a material which can be penetrated by plant roots and a layer of plant seeds; and a coating whereby the laminate structure is held together.

2. A growth medium as claimed in claim 1 wherein the resin is a polyurethane resin.

3. A growth medium as claimed in either of claims 1 or 2 wherein the resin has a predominantly open pored structure.

4. A growth medium as claimed in any one of the preceding claims wherein the foamed resin incorporates particles of peat.

5. A growth medium as claimed in any one of the preceding claims wherein the plant nutrient and/or plant root penetrable material is/are concentrated at or near the face of the synthetic resin layer closest the seed layer.

6. A growth medium as claimed in any one of the preceding claims wherein a layer

of peat and/or fertilizer material is provided between the foamed synthetic resin and the layer of plant seeds.

7. A plant growth medium as claimed in any one of the preceding claims wherein the plant seeds are grass seeds.

8. A plant growth medium as claimed in any one of the preceding claims wherein the bonding coating comprises a soil stabiliser and/or a urea/aldehyde condensate.

9. A plant growth medium as claimed in any one of the preceding claims wherein the coating impregnates the growth medium.

10. A plant growth medium as claimed in any of the preceding claims provided with means for rendering the laminated structure more rigid.

11. A plant growth medium as claimed in claim 10 wherein the foamed resin layer is formed with a surface skin thereto.

12. A plant growth medium as claimed in any of the preceding claims provided with a plant root impervious basal layer.

13. A plant growth medium as claimed in any of the preceding claims comprising a layer of plant root impervious synthetic resin sheeting having thereon a layer of foamed polyurethane resin incorporating particles of peat, a subsequent layer of a peat/fertilizer mixture, a subsequent layer of grass seed and a coating of a urea/aldehyde condensate.

14. A plant growth medium as claimed in claim 1 substantially as hereinbefore described.

15. A plant growth medium as claimed in claim 1 substantially as hereinbefore described with respect to and as shown in the accompanying drawings.

16. A method for forming a plant growth medium comprising a laminated structure as claimed in any of the preceding claims which comprises forming a layer of a foamed synthetic plant physiologically acceptable resin incorporating a plant nutrient; forming a layer of seeds superimposed on the layer of foamed resin; and applying a coating to the resultant laminated structure so as to hold the two layers together.

17. A method as claimed in claim 16 wherein the resin layer is formed so that it has an external skin and the layer is cut before application of the seed layer so as to expose an open pored surface.

18. A method as claimed in claim 16 wherein particles of plant nutrient and/or a material which can be penetrated by plant roots are placed upon a surface to which is fed a mixture capable of forming a foamed synthetic resin.

19. A method as claimed in claim 18 wherein the particles are fed to a moving belt to which is fed a foaming or foamable polyurethane resin or precursors thereof.

20. A method as claimed in any of claim 16 to 19 in which the coating is applied as a spray of a liquid.

21. A method as claimed in claim 20 wherein the plant growth medium is subjected to a subsequent treatment to dry and/or cure the coating.

22. A method as claimed in claim 16 for forming a plant growth medium substantially as hereinbefore described.

23. A plant growth medium when produced by a method as claimed in any of claims 16 to 22.

24. A method for growing plants which comprises propagating a plant growth medium as claimed in any of claims 1 to 15 and 23.

25. A grass turf when produced by the method of claim 24.

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1475994 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*